Kardiologia Polska 2016; 74, 9: 985–993; DOI: 10.5603/KP.a2016.0038 ISSN 0022–9032

ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Complete atrioventricular block after isolated aortic valve replacement

Andrzej Klapkowski[1], Rafał Pawlaczyk[1], Maciej Kempa[2], Dariusz Jagielak[1], Maciej Brzeziński[1], Jan Rogowski[1]

[1]Department of Cardiac and Vascular Surgery, Medical University of Gdansk, Gdansk, Poland

[2]Department of Cardiology and Cardiac Electrotherapy, Medical University of Gdansk, Gdansk, Poland

Abstract

Background: Temporary atrioventricular (AV) conduction disturbances are a common complication following cardiac surgery, especially involving the aortic valve. Permanent complete AV block is a serious and rare complication. Its prevalence has been estimated at 3–6% of all patients undergoing aortic valve replacement. Identification of factors that affect the occurrence of complete AV block requiring permanent pacemaker implantation might help reduce the risk of this problem in the future.

Aim: To evaluate clinical, anatomical and surgical factors that might affect occurrence of complete AV, resulting in the need for permanent pacemaker implantation.

Methods: In our prospective study, we analysed clinical data of consecutive 159 patients operated due to isolated aortic valve disease between February 2011 and March 2012. Patients with a pacemaker implanted before that time were excluded from the study. The main indication for surgery was aortic stenosis (n = 114, 71.7%). Infectious endocarditis was an indication in 6 (3.8%) cases. Mean patient age was 65.3 ± 11.4 years, and the proportion of males to females was 56.6%/43.4%. Overall, 135 (84.9%) patients had sinus rhythm preoperatively. All operations were performed using median sternotomy, cardiopulmonary bypass, and hypothermia at 30–32°C. A biological prosthesis was implanted in 120 (70.4%) patients. Patients who needed an additional procedure such as another valve surgery, aortic surgery or coronary artery bypass grafting were excluded from the study.

Results: Permanent pacemaker implantation was required in 11 (6.9%) patients. The pacemaker was implanted after at least 7 days of complete AV block which was then considered permanent. Univariate analysis showed that permanent pacemaker implantation was associated with prolonged cardiopulmonary bypass time, prolonged aortic cross-clamp time, and the occurrence of electrolyte disturbances. Univariate logistic regression revealed that the need for permanent pacemaker implantation depended on 5 factors including prolonged cardiopulmonary bypass time, prolonged aortic cross-clamp time, larger size of the implanted valve prosthesis, endocarditis as the indication for surgery, and electrolyte disturbances. In both backward and forward stepwise multivariate regression models, two parameters, prolonged aortic cross-clamp time and the presence of electrolyte disturbances, correlated with the occurrence of complete AV block.

Conclusions: Permanent complete AV block is a serious complication after aortic valve surgery. Of all analysed clinical, anatomical and surgical factors, prolonged cardiopulmonary bypass time, prolonged aortic cross-clamp time, larger size of the implanted valve prosthesis, endocarditis as the indication for surgery, and electrolyte disturbances were found to be statistically significant predictors of permanent pacemaker implantation.

Key words: aortic valve replacement, complete atrioventricular block, permanent pacemaker implantation

Kardiol Pol 2016; 74, 9: 985–993

INTRODUCTION

A significant increase in the number of patients referred for surgical treatment of aortic valve disease has been seen in the recent years. This is related to both improved diagnosis of cardiac disease and population aging. Atrioventricular (AV) conduction disturbances are commonly seen following cardiac surgery, in particular in patients after aortic valve replacement and tricuspid valve repair. Complete or 3rd degree AV block

Address for correspondence:
Andrzej Klapkowski, MD, Department of Cardiac and Vascular Surgery, Medical University of Gdansk, ul. Dębinki 7, 80–952 Gdańsk, Poland, e-mail: a.klapkowski@gmail.com
Received: 20.07.2015 **Accepted:** 22.03.2016 **Available as AoP:** 01.04.2016

Table 1. Baseline characteristics of the overall study group and patients who required or did not require permanent pacing

Parameter	Study group (n = 159)	Permanent pacing (n = 11)	No permanent pacing (n = 148)	P
Gender:				0.8865
Women	69 (43.4%)	5 (45.4%)	64 (43.2%)	
Men	90 (56.6%)	6 (54.6%)	84 (56.8%)	
Age at the time of the surgery, mean (SD)	65.3 (11.4)	59.2 (11.9)	65.7 (11.3)	0.0565
Diagnosis:				0.0708
AS	114 (71.7%)	6 (54.5%)	108 (73.0%)	
AS + AR	27 (17.0%)	2 (18.2%)	25 (16.9%)	
AR	12 (7.5%)	1 (9.1%)	11 (7.4%)	
Infective endocarditis	6 (3.8%)	2 (18.2%)	4 (2.7%)	
Cardiac rhythm and conduction disturbances before surgery:				0.1893
Sinus rhythm	135 (84.9%)	10 (90.9%)	125 (84.4%)	
AF	14 (8.8%)	0 (0.0%)	14 (9.4%)	
LBBB	5 (3.1%)	0 (0.0%)	5 (3.4%)	
RBBB	2 (1.3%)	1 (9.1%)	1 (0.7%)	
1st degree AV block	2 (1.3%)	0 (0.0%)	2 (1.4%)	
Other	1 (0.6%)	0 (0.0%)	1 (0.7%)	
Ischaemic heart disease	40 (25.2%)	3 (27.3%)	37 (25.0%)	0.8669
Mitral valve disease	7 (4.4%)	1 (9.1%)	6 (4.1%)	0.4321
Diabetes	39 (24.5%)	3 (27.3%)	36 (24.3%)	0.8264
Hypertension	91 (57.2%)	5 (45.5%)	86 (58.1%)	0.4131
Heart failure	27 (17.0%)	0 (0.0%)	27 (18.2%)	0.1200
Previous cardiac surgery	6 (3.8%)	0 (0.0%)	6 (4.1%)	0.4960
Aortic valve reoperation	4 (2.5%)	1 (9.1%)	3 (2.0%)	0.1489

AF — atrial fibrillation; AR — aortic regurgitation; AS — aortic stenosis;, AV — atrioventricular; LBBB — left bundle branch block; RBBB — right bundle branch block; SD — standard deviation

with a need to implant a permanent cardiac pacemaker is an established and reported complication of aortic valve replacement. The rate of this severe complication has been reported in the literature at 3–6.5% [1, 2]. Factors that may predispose to complete AV block following aortic valve replacement have not been well established, and previous studies that evaluated causes of this complication did not arrive at any clear conclusions.

The aim of our prospective study was to evaluate the effect of selected clinical, anatomical and surgical factors on the rate of complete AV block requiring permanent pacemaker implantation following aortic valve replacement.

METHODS

We prospectively analysed the perioperative course in 159 patients who underwent isolated aortic valve replacement in our centre between February 2011 and March 2012. Characteristics of the study population are shown in Tables 1 and 2. Patients with an implanted pacemaker and those who required an additional surgical procedure such as coronary artery bypass or another valve replacement or repair were excluded from the study.

Patients who required permanent pacemaker implantation due to complete AV block were included in the Group A. The remaining patients were included in the Group B.

The major indication for surgery was aortic stenosis (n = 114, 71.7%). Surgery was indicated due to aortic regurgitation in 12 (7.5%) patients, and due to combined aortic stenosis and regurgitation in 27 (17%) patients. Patients with infective endocarditis comprised 3.8% of the study group (n = 6). Bileaflet aortic valve was found in 32 (20.1%) patients, and 19 (11.9%) patients had a functionally bileaflet valve. Annular calcifications were present in 97 (61.4%) patients. All patients underwent echocardiography which was the basis for referral for the surgery. Patients above 40 years of age underwent coronary angiography. Data were

Table 2. Intra- and postoperative characteristics of the overall study group and patients who required or did not require permanent pacing

Parameter	Study group (n = 159)	Permanent pacing (n = 11)	No permanent pacing (n = 148)	P
Aortic valve:				0.7270
Tricuspid	106 (66.7%)	9 (81.9%)	97 (65.5%)	
Bileaflet	32 (20.1%)	1 (9.1%)	31 (20.9%)	
Functionally bileaflet	19 (11.9%)	1 (9.1%)	18 (12.2%)	
Other	2 (1.3%)	0 (0.0%)	2 (1.4%)	
Annular calcifications	97 (61.4%)	6 (54.5%)	91 (61.9%)	0.6287
Implanted valve prosthesis:				0.2311
Biological	112 (70.4%)	6 (54.5%)	106 (71.6%)	
Mechanical	47 (29.6%)	5 (45.5%)	42 (28.4%)	
Size of the implanted valve prosthesis, mean (SD)	22.6 (1.9)	23.7 (2.6)	22.5 (1.8)	0.1445
Operation performed by a specialist	108 (67.9%)	8 (72.7%)	100 (67.6%)	0.7236
Duration of cardiopulmonary bypass [min], mean (SD)	115.4 (31.7)	135.5 (27.9)	113.9 (31.5)	0.0069
Duration of aortic cross-clamp [min], mean (SD)	74.5 (20.7)	89.5 (21.7)	73.4 (20.2)	0.0105
Body temperature during CPB [°C], mean (SD)	31.5 (1.1)	31.5 (1.8)	31.5 (1.1)	0.6036
Cardiac rhythm at the end of surgery:				0.0001
Sinus	118 (74.2%)	4 (36.4%)	114 (77.0%)	
Paced (slow intrinsic rhythm)	12 (7.5%)	3 (27.3%)	9 (6.1%)	
Paced (complete AV block)	12 (7.5%)	4 (36.4%)	8 (5.4%)	
AF	17 (10.7%)	0 (0.0%)	17 (11.5%)	
Technique of valve prosthesis insertion:				0.3374
Single sutures	153 (96.2%)	10 (90.9%)	143 (96.6%)	
Semicontinuous sutures	6 (3.8%)	1 (9.1%)	5 (3.4%)	
Electrolyte disturbances	10 (6.4%)	3 (27.3%)	7 (4.8 %)	0.0032
Need for reoperation	17 (10.7%)	1 (9.1%)	16 (10.8%)	0.8587
Postoperative arrhythmia and conduction disturbances:				0.0001
AF	36 (22.6%)	0 (0.0%)	36 (24.7%)	
AV block	20 (12.6%)	11 (100%)	9 (6.2%)	
LBBB	7 (4.4%)	0 (0.0%)	7 (4.8%)	
RBBB	1 (0.6%)	0 (0.0%)	1 (0.7 %)	
Other	2 (1.3%)	0 (0.0%)	2 (1.4%)	
Pacing in the postoperative period	33 (20.9%)	11 (100%)	22 (15%)	0.0001
Need for permanent pacemaker implantation	11 (6.9%)			

CPB — cardiopulmonary bypass; other abbreviations — see Table 1

collected using a specially designed questionnaire. Patients were evaluated before the surgery and on each day of the postoperative period until hospital discharge. Data on the procedural course, operative technique, and the type of valve prosthesis were retrieved from the operative summary. We analysed 11 preoperative, 14 intraoperative, and 7 postoperative factors for their potential effect on the occurrence of complete AV block and the need for permanent pacemaker implantation.

Operative technique

All procedures were performed using conventional midline approach and median sternotomy. Cardiopulmonary bypass was used during all procedures, with the flow rate of 2.4––2.8 L/min/m^2 and the perfusion pressure of 60–80 mm Hg. Procedures were performed in hypothermia (30–32°C). Myocardial protection was provided with crystalline cardioplegia selectively into coronary ostia and/or retrogradely using a coronary sinus cannula, depending on the operator preference.

Left ventricle was drained via the right upper pulmonary vein. The native aortic valve was resected in all cases, with removal of annular calcifications.

Postoperative follow-up

Following the surgery, patients were managed in an intensive postoperative care unit. Standard monitoring included the following vital parameters: 5-lead electrocardiogram (ECG), central venous pressure, oxygen saturation, and blood pressure by invasive measurement. Electrolyte disturbances were defined as serum potassium level below 3.5 mmol/L or above 5.5 mmol/L, serum magnesium level below 0.8 mmol/L or above 1.2 mmol/L, and serum calcium level below 2 mmol/L or above 2.6 mmol/L. All patients were protected with an epicardial lead, and external pacing was used in case of complete AV block or other bradyarrhythmia. The indication for permanent pacemaker implantation was persistence of complete AV block above 7 days.

Statistical analysis

All statistical calculations were performed using the STATISTICA 10.0 package (StatSoft, Inc. 2011) and the Excel spreadsheet. The Shapiro-Wilk test was used to verify normal distribution of quantitative variables. Qualitative variables were evaluated using the χ^2 test of independence (using Yates correction for samples below 10, Cochrane's rule verification, or exact Fisher test). Pearson and/or Spearman correlation coefficients were calculated to determine associations between variables, their strength, and directions. Significance was set at $p = 0.05$ for all calculations.

RESULTS

Permanent pacemaker implantation was necessary in 11 patients (6.9%, Group A). Preoperative factors including age, gender, cardiac rhythm, presence of conduction disturbance, hypertension, diabetes, mitral valve disease, previous myocardial infarction, previous cardiac surgery, and aortic valve reoperation did not differ significantly between the two groups (Table 1).

Among intraoperative factors, duration of cardiopulmonary bypass and aortic cross-clamp was significantly longer in group A ($p = 0.0069$ and $p = 0.0105$, respectively, by univariate analysis). Among the evaluated postoperative factors, electrolyte disturbances were significantly more frequent in patients in group A ($p = 0.015$) (Table 2).

Intraoperative data including patient's age at the time of the surgery, valve morphology (bileaflet, functionally bileaflet, tricuspid), presence of annular calcifications, valve prosthesis type (biological, mechanical), body temperature during cardiopulmonary bypass, technique of valve insertion (semicontinuous or single sutures), cardiac rhythm at the end of the procedure, and operation performance by a specialist or surgeon in training, did not show significant differences between the two groups. A trend was noted for more frequent occurrence of AV block in younger patients but this difference was not significant ($p = 0.0565$).

Among the analysed postoperative data (electrolyte disturbances, need for reoperation, postoperative arrhythmia, need for temporary pacing postoperatively), only the presence of electrolyte disturbances and occurrence of AV block requiring temporary pacing using an epicardial lead were more frequent among those patients who required permanent pacemaker implantation (Table 2).

In addition, univariate logistic regression model indicated that the need for permanent pacemaker implantation was significantly related to 5 variables: duration of cardiopulmonary bypass, duration of aortic cross-clamp, size of the implanted valve prosthesis, the diagnosis of infective endocarditis, and the presence of electrolyte disturbances.

The likelihood of the need for permanent pacemaker implantation increases with longer duration of cardiopulmonary bypass, duration of aortic cross-clamp, size of the implanted valve prosthesis. The diagnosis of infective endocarditis and the presence of electrolyte disturbances were also associated with an increased likelihood of the need for permanent pacemaker implantation. Detailed data are presented in Table 3.

In both multivariate regression models, backward and forward stepwise, only two parameters, duration of aortic cross-clamp and the presence of electrolyte disturbances, were found to be significantly associated with the need for permanent pacemaker implantation. In this analysis, longer duration of aortic cross-clamp and the presence of electrolyte disturbances were associated with an increased likelihood of the need for permanent pacemaker implantation. Detailed data are presented in Table 4.

Patients who required permanent pacemaker implantation had their pacemakers checked up in the last quarter of 2015. Six patients showed up for the follow-up examination, and information regarding 4 patients was obtained from the treating cardiologists. One patient was lost to follow-up. In this group, 6 patients required permanent ventricular pacing (pacing-dependent), and 4 patients required pacing only for several per cent of the time or did not need pacing at all, i.e. did not require a pacemaker during long-term follow-up. Follow-up data are shown in Table 5.

DISCUSSION

In our study, annular calcifications were present in 6 (54.5%) patients in Group A (with the need for permanent pacemaker implantation) and in 91 (61.9%) patients in Group B. This difference was found to be not significant in our study, although an association between annular calcifications and the need for permanent pacemaker implantation was reported by other authors [1].

Bileaflet aortic valve is a common congenital heart anomaly, present in 1–2% of the general population. Patients with

Table 3. Logistic regression — univariate model

Variable	P	Odds ratio	95% CI
Age at the time of the surgery	0.0720	0.96	0.91; 1.00
Duration of cardiopulmonary bypass	0.0430	1.02	1.00; 1.03
Duration of aortic cross-clamp	0.0200	1.03	1.01; 1.05
Temperature	0.8510	0.95	0.57; 1.59
Valve prosthesis size	0.0480	1.32	1.00; 1.75
Diagnosis: AS + AR	0.5430	0.67	0.19; 2.43
Diagnosis: AR	0.7470	0.76	0.15; 3.96
Diagnosis: infective endocarditis	0.0500	4.19	1.00; 17.58
Diagnosis: AS	0.1250	0.47	0.18; 1.24
Ischaemic heart disease	0.8670	1.06	0.53; 2.11
Mitral valve disease	0.4450	1.54	0.51; 4.65
Diabetes	0.8270	1.08	0.54; 2.15
Hypertension	0.4170	0.78	0.42; 1.43
Reoperation	0.1890	2.20	0.68; 7.13
Annular calcifications	0.6300	0.86	0.46; 1.59
Mechanical valve prosthesis	0.2400	1.45	0.78; 2.70
Biological valve prosthesis	0.2400	0.69	0.37; 1.28
Operation by a specialist	0.7240	1.13	0.57; 2.25
Valve prosthesis insertion technique: semicontinuous sutures	0.3580	1.69	0.55; 5.19
Valve prosthesis insertion technique: single sutures	0.3580	0.59	0.19; 1.81
Electrolyte disturbances	0.0100	2.73	1.27; 5.86
Need for reoperation	0.8590	0.91	0.32; 2.62

CI — confidence interval; other abbreviations — see Table 1

Table 4. Logistic regression — multivariate model

Variable	P	Odds ratio	95% CI
Backward stepwise			
Duration of aortic cross-clamp	0.044	1.03	1; 1.05
Electrolyte disturbances	0.026	2.47	1.11; 5.48
Forward stepwise			
Duration of aortic cross-clamp	0.044	1.03	1; 1.05
Electrolyte disturbances	0.026	2.47	1.11; 5.48

CI — confidence interval

this defect are prone to the development of aortic stenosis or regurgitation. Despite reports on the association between the presence of bileaflet aortic valve and the rate of postoperative complete AV block [1], we were unable to identify such an association in our study.

Aortic regurgitation due to infective endocarditis was the indication for surgery in 2 patients in Group A (18.2%) and in 4 patients in Group B (2.7%). In univariate logistic regression model, this difference was found to be significant ($p = 0.05$). Thus, it may be concluded that the diagnosis of infective endocarditis is one factor that may predispose to postoperative AV conduction disturbances. However, a small number of patients with infective endocarditis in our study may render our analysis inaccurate, and this issue requires further attention and reanalysis during study continuation.

Aortic regurgitation was the indication for surgery in 12 (7.5%) patients, including 1 patient in Group A (9.1%) and 11 patients in Group B (7.4%). We did not find significant differences between the two groups in regard to the type of aortic valve disease which was the indication for the surgery.

Table 5. Patients who required permanent pacemaker implantation — follow-up as of December 2015

Patient	Type of implanted pacemaker	Ventricular pacing [%]	Cardiac rhythm
1	DDD	Several	Sinus rhythm
2	DDD	0%	Sinus rhythm
3	DDD	0%	Sinus rhythm
4	DDD	100%	AF with complete AV block
5	No data	No data	No data
6	DDD	100%	Sinus rhythm with complete AV block
7	DDD	0%	Sinus rhythm
8	VVI, ICD	100%	AF with complete AV block
9	DDD	100%	Sinus rhythm with complete AV block
10	DDD	100%	Sinus bradycardia with complete AV block
11	DDD	100%	Sinus bradycardia with complete AV block

AF — atrial fibrillation; AV — atrioventricular

Our study did not confirm observations of other authors, suggesting that aortic regurgitation is a factor predisposing to permanent AV conduction disturbances [2–5].

The presence of preoperative conduction disturbances including 1st degree AV block, and right or left bundle branch block, was not found to be associated with the need for permanent pacemaker implantation in our study despite suggested [1, 2], obvious association with the occurrence of postoperative complete AV block.

The presence of such conditions as hypertension, diabetes, previous myocardial infarction, mitral valve disease, and heart failure was also not associated with an increased risk of postoperative complete AV block in our study. Some authors observed such relationship [1, 3] but these observations were not confirmed in our study.

Among factors associated with operative technique such as valve prosthesis insertion technique (semicontinuous or single suture) and thus intraannular or supraannular prosthesis insertion, respectively; type of valve prosthesis (biological, mechanical), and body temperature during cardiopulmonary bypass, none was found to be associated with the occurrence of postoperative complete AV block requiring permanent pacemaker implantation. Similar observations were made by Keefe et al. [6] while Totaro et al. [7] found that valve prosthesis implantation using semicontinuous sutures was associated with more frequent occurrence of complete AV block. Duration of both cardiopulmonary bypass and aortic cross-clamp was significantly higher in Group A in both univariate analysis and by univariate and multivariate logistic regression (Tables 2–4). Both these parameters are non-specific indicators of intraoperative problems and tend to be longer with more severe valve degeneration requiring intensive decalcification. Although we did not find significant differences between the two groups in regard to the presence of annular calcification, longer duration of cardiopulmonary bypass and aortic cross-clamp may indicate that complete AV block is more common in patients with a severely degenerated valve. Similar observations were made by Elahi et al. [8] and Erdogan et al. [1].

Univariate logistic regression showed that patients in Group A had significantly larger valve prostheses implanted. There is a theoretical possibility of an increased compression of the cardiac conduction system by large valve prostheses, but this might have also been an incidental finding. This issue requires further observation and analysis during study continuation.

Among the evaluated postoperative parameters, only electrolyte disturbances were significantly more common among patients in Group A, as shown in both univariate analysis and by univariate and multivariate logistic regression. Thus, our study confirmed observations of other authors [3]. This correlation may be indirectly associated with long duration of the surgery, as electrolyte disturbances are more frequently seen in those patients in whom duration of myocardial ischaemia and cardiopulmonary bypass are longer.

Perioperative pacing using epicardial pacing was needed in all patients in Group A and in 15% of patients in Group B. This observation indicates that AV conduction disturbances were transient in some patients, and time to their resolution is shown in Figure 1.

Transient postoperative AV conduction disturbances may develop following cardiac surgery, requiring temporary pacing. Various degree AV blocks, bundle branch blocks, and sinus node dysfunction may resolve, possibly with return of sinus rhythm [6]. Time after which perioperative AV block should be considered permanent, and thus permanent pacemaker implantation is indicated, is a controversial issue. Sinus rhythm return has been observed even several days after the surgery. In our study, similarly to other authors [1, 2], we considered

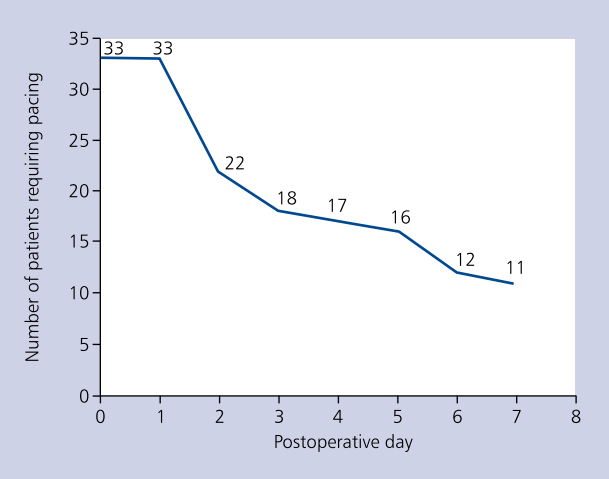

Figure 1. Number of patients requiring pacing on subsequent postoperative days

10 days as the period after which a permanent pacemaker should be implanted for complete AV block. A factor accelerating this decision is often rapidly increasing pacing threshold of the epicardial lead that was placed intraoperatively. As shown by the follow-up evaluation of patients with a pacemaker implanted, this decision turned out to be too hasty in many of them. Perhaps the waiting period in patients with complete AV block should be extended by another several days, obviously on condition that the effectiveness of epicardial pacing in a patient without adequate escape rhythm is not decreasing.

Conduction disturbances following cardiac surgery may be explained by various mechanisms, including manipulation close to the cardiac conduction system resulting in its mechanical damage, and extensive coronary lesions preventing proper cardioprotection during cardiac arrest, resulting in ischaemia. Both these mechanisms may operate during aortic valve replacement.

Atrioventricular block after aortic valve replacement is usually a consequence of His bundle traumatisation following annular decalcification in the area of membranous septum and the right fibrous triangle below the right-noncoronary commissure. While mechanical damage mostly results in a permanent block, haematoma or oedema of the surrounding tissues usually leads to a transient block resolving within a few days. Careful decalcification and cautious suturing in this area may decrease the rate of conduction disturbances [9]. On the other hand, too shallow suturing may result in a perivalvular leak. This most surgeons prefer operative techniques that allow firm attachment of the valve prosthesis to the aortic annulus, as reoperation that might be need due to a perivalvular leak is associated with much higher risk than pacemaker insertion.

Despite better understanding of the potential causes of complete AV block following surgical treatment of aortic valve disease, this is no universal approach to avoid this complication. More recent transcatheter aortic valve implantation techniques are associated with even higher risk of postoperative conduction disturbances, most commonly complete AV block (rate 9–49%, mean 20.8%) [10, 11]. The reason for this is even higher traumatisation of the aortic annulus, associated with that fact that calcified tissues and a metal stent are pushed under high pressure into susceptible structures of the cardiac conduction system.

CONCLUSIONS

Irreversible complete AV block is a rare but serious complication after aortic valve replacement. Identification of factors potentially affecting occurrence of this complication might help avoid such factors. In our study group, we evaluated clinical, anatomical and surgical factors for their association with the occurrence of permanent AV block. Factors significantly associated with an increased rate of this complication included electrolyte disturbances, larger size of the implanted valve prosthesis, the diagnosis of infective endocarditis as the indication for surgery, and prolonged duration of cardiopulmonary bypass and aortic cross-clamp.

Conflict of interest: *none declared*

References

1. Erdogan H, Kayalar N, Ardal H et al. Risk factors for requirement of permanent pacemaker implantation after aortic valve replacement. J Card Surg, 2006; 21: 211–215. doi: 10.1111/j.1540-8191.2006.00216.x.
2. Matthews I, Iftikhar A, Fazal A et al. In patients undergoing aortic valve replacement, what factors predict the requirement for permanent pacemaker implantation? Interactive CardioVascular Thoracic Surg, 2011; 12: 475–479. doi: 10.1510/icvts.2010.254607.
3. Limongelli G, Ducceschi V, D'Andrea A et al. Risk factors for pacemaker implantation following aortic valve replacement: a single centre experience. Heart, 2003; 89: 901–904.
4. Huynh H, Dalloul G, Ghanbari H et al. Permanent pacemaker implantation following aortic valve replacement: current prevalence and clinical predictors. Pacing Clin Electrophysiol, 2009; 32: 1520–1525. doi: 10.1111/j.1540-8159.2009.02552.x.
5. Dawkins S, Hobson A, Kalra P et al. Permanent pacemaker implantation after isolated aortic valve replacement: incidence, indications and predictors. Ann Thorac Surg, 2008; 85: 108–112.
6. Keefe D, Griffin J, Harrison D, Stinson E. Atrioventricular conduction abnormalities in patients undergoing isolated aortic or mitral valve replacement. PACE, 1985; 8: May-June.
7. Totaro P, Calamai G, Montesi G et al. Continuous suture technique and impairment of atrioventricular conduction after aortic valve replacement. J Card Surg, 2000; 15: 418–422.
8. Elahi M, Usmaan K. The bioprosthesis type and size influence the postoperative incidence of permanent pacemaker implantation in patients undergoing aortic valve surgery. J Interv Card Electrophysiol, 2006; 15: 113–118.
9. Nardi P, Pellegrino A, Scafuri A et al. Permanent pacemaker implantation after isolated aortic valve replacement: incidence, risk factors and surgical technical aspects. J Cardiovasc Med, 2010; 11: 14–19.
10. Kostopoulou A, Karyofillis P, Livanis E et al. Permanent pacing after transcatheter aortic valve implantation of

a CoreValve prosthesis as determined by electrocardiographic and electrophysiological predictors: a single-centre experience. Europace, 2016; 18: 131–137. doi: 10.1093/europace/euv137.

11. Van der Boon R, Houthuizen P, Urena M et al. Trends in the occurrence of new conduction abnormalities after transcatheter aortic valve implantation. Catheter Cardiovasc Intervent, 2015; 85: 144–152. doi: 10.1002/ccd.25765.

Cite this article as: Klapkowski A, Pawlaczyk R, Kempa M et al. Complete atrioventricular block after isolated aortic valve replacement. Kardiol Pol, 2016; 74: 985–993. doi: 10.5603/KP.a2016.0038.

Całkowity blok przedsionkowo-komorowy po operacjach wymiany zastawki aortalnej

Andrzej Klapkowski[1], Rafał Pawlaczyk[1], Maciej Kempa[2], Dariusz Jagielak[1], Maciej Brzeziński[1], Jan Rogowski[1]

[1]Katedra i Klinika Kardiochirurgii i Chirurgii Naczyniowej, Gdański Uniwersytet Medyczny, Gdańsk

[2]Klinika Kardiologii i Elektroterapii Serca, Gdański Uniwersytet Medyczny, Gdańsk

Streszczenie

Wstęp: Czasowe zaburzenia przewodzenia przedsionkowo-komorowego (AV) po zabiegach kardiochirurgicznych, a szczególnie dotyczących zastawki aortalnej, są dosyć często występującym powikłaniem. Pojawienie się tych zaburzeń może mieć poważne konsekwencje dla operowanego chorego. Mimo starań chirurga, aby ze szczególną delikatnością i precyzją zakładać szwy na pierścień zastawki aortalnej w okolicy ranliwej, istnieje ryzyko trwałego uszkodzenia układu bodźcoprzewodzącego serca. Jego występowanie po wszczepieniu protezy zastawki aortalnej i związana z nim konieczność implantacji stymulatora na stałe szacuje się na 3–6%. Określenie czynników mogących wpływać na częstość występowania bloku całkowitego i konieczność implantacji na stałe urządzenia stymulującego pracę serca mogłoby być korzystne i pozwolić na zmniejszenie ryzyka występowania tego problemu w przyszłości.

Cel: Celem pracy była ocena wpływu parametrów klinicznych, anatomicznych i chirurgicznych na częstość występowania całkowitego bloku AV po operacjach wszczepienia protezy zastawki aortalnej i konieczność implantacji stymulatora serca na stałe.

Metody: Prospektywnie analizowano dane 159 kolejnych chorych operowanych z powodu izolowanej wady aortalnej między lutym 2011 a marcem 2012 r. Pacjentów z implantowanym wcześniej stymulatorem serca wykluczono z badania. Głównym wskazaniem do operacji było zwężenie zastawki aortalnej (n = 114; 71,7%). Infekcyjne zapalenie wsierdzia było wskazaniem do operacji u 6 (3,8%) pacjentów. Średni wiek podczas zabiegu wynosił 65,3 ± 11,4 roku. Kobiety stanowiły 43,4% populacji. U większości pacjentów przed zabiegiem stwierdzono rytm zatokowy (n = 135; 84,9%). Wszystkie zabiegi wykonano z dostępu przez sternotomię pośrodkową w krążeniu pozaustrojowym w hipotermii 30–32°C. Zastawka aortalna była wycinana w całości, pierścień dekalcyfikowany, następnie implantowano protezę. W zależności od preferencji chirurga protezę wszywano śródpierścieniowo za pomocą szwów półciągłych lub nadpierścieniowo szwami na podkładkach od strony komory. U 120 (70,4%) pacjentów implantowano protezę biologiczną. Bezpośrednio po zabiegu chorzy przebywali na oddziale intensywnego nadzoru pooperacyjnego, następnie po wybudzeniu i uzyskaniu stabilności stanu ogólnego byli przekazywani na dzienny oddział kardiochirurgii. Pacjenci, u których zaistniała konieczność wykonania dodatkowej procedury, takiej jak pomostowanie naczyń wieńcowych czy wymiana lub naprawa innej zastawki, zostali wykluczeni z badania.

Adres do korespondencji:
lek. Andrzej Klapkowski, Klinika Kardiochirurgii i Chirurgii Naczyniowej, Uniwersyteckie Centrum Kliniczne, Gdański Uniwersytet Medyczny, ul. Dębinki 7, 80–952 Gdańsk, e-mail: a.klapkowski@gmail.com

Praca wpłynęła: 20.07.2015 r. **Zaakceptowana do druku:** 22.03.2016 r. **Data publikacji AoP:** 01.04.2016 r.

Wyniki: U 11 pacjentów wystąpiła konieczność implantacji stymulatora na stałe (6,9%). Implantację stymulatora przeprowadzano po co najmniej 7 dniach od wystąpienia całkowitego bloku AV, uznając go wówczas za nieodwracalny. Analiza jednoczynnikowa wykazała, że konieczność implantacji stymulatora na stałe zależy od wydłużonego czasu krążenia pozaustrojowego, wydłużonego czasu zaklemowania aorty i wystąpienia zaburzeń elektrolitowych. Model regresji jednoczynnikowej pozwala stwierdzić, że konieczność implantacji stymulatora na stałe istotnie statystycznie zależy od 5 parametrów: wydłużonego czasu krążenia pozaustrojowego, wydłużonego czasu zaklemowania aorty, rozmiaru implantowanej zastawki (im większy rozmiar tym częstszy blok całkowity), rozpoznania infekcyjnego zapalenia wsierdzia oraz zaburzeń elektrolitowych. Dla obu modeli regresji wieloczynnikowej (krokowa wsteczna i postępująca) otrzymano dwa parametry: wydłużony czas zaklemowania aorty i występowanie zaburzeń elektrolitowych, których obecność istotnie koreluje z koniecznością implantacji stymulatora na stałe.

Wnioski: Nieodwracalny całkowity blok AV stanowi poważne powikłanie występujące po operacjach zastawki aortalnej. Spośród analizowanych parametrów klinicznych, anatomicznych i chirurgicznych wydłużony czas krążenia pozaustrojowego, wydłużony czas zaklemowania aorty, większy rozmiar implantowanej zastawki, infekcyjne zapalenie wsierdzia jako przyczyna kwalifikacji do zabiegu oraz występowanie zaburzeń elektrolitowych w okresie okołooperacyjnym są czynnikami istotnie statystycznie wpływającymi na częstość występowania całkowitego bloku AV i konieczność implantacji stymulatora serca na stałe.

Słowa kluczowe: wymiana zastawki aortalnej, całkowity blok przedsionkowo-komorowy, implantacja stymulatora

Kardiol Pol 2016; 74, 9: 985–993